muscularly, but even if it had been, it would not necessarily have supported his claim.

Chapters ii. and iii. deal with the principles involved in vaccine therapy and with the determination of the opsonic index. The author is so strong a believer in the utility of the opsonic index in diagnosis, prognosis, and as a guide in vaccination that a critical review of the subject could not be expected of him, and we do not get it.

The chapters on the methods of obtaining pure cultures of infecting micro-organisms and on the preparation of their corresponding vaccines are well executed. Some micro-organisms, however, like the bacillus of Friedländer and the *Bacillus septus*, receive more attention and consideration than is consistent with our present knowledge as to the *rôle* played by them in disease.

Naturally a large amount of space is devoted to infections caused by the tubercle bacillus. As a result of his own experience the author recommends a mixture of human and bovine tuberculins. The dosage apparently differs enormously according to the guides followed. These may be clinical symptoms, the opsonic index, or common sense. Such multiplication of immunisation systems can only lead to confusion.

The remaining chapters deal with the application of vaccine therapy to many other forms of infection, and the results that have hitherto been achieved.

SCIENCE OUT OF SCHOOL.

Chambers's Wonder Books. (1) *The Wonder Book of Volcanoes and Earthquakes.* By Prof. E. J. Houston. Pp. x+369. (2) *The Wonder Book of the Atmosphere.* By the same author. Pp. ix+326. (3) *Electricity for Young People.* By Tudor Jenks. Pp. viii+317. (4) *Photography for Young People.* By the same author. Pp. x+328. (New York: Frederick A. Stokes Co.; London and Edinburgh: W. and R. Chambers, Ltd., 1908.) Price 3*s.* 6*d.* each.

THE proper function of books of the type under review is to awaken interest in the boys to whom they are addressed. This may be accomplished by appealing to the boy's love of adventure or of animals; or the appeal may be to the constructional instinct, in which case the book should bring science into direct relation with the boy's interests and environment, suggesting to him possibilities of experiment upon his own account. On a higher intellectual level we have to deal with the lad who has reached a more mature stage of mental development and has risen to the height of strictly scientific interests. He now desires *rerum cognoscere causas*, and seeks knowledge in order to obtain intellectual control of natural forces. A valuable stage in his culture will be achieved if at this epoch we can give him an historical survey of the growth of scientific discovery. In such popular histories it is difficult to avoid excess of biography in the earlier portions, and excess of technicality as the present day is approached. Books dealing with boys' hobbies are numerous, and (we are glad to add) often enjoy success. Of the higher type of book—specimens of well-written, untechnical scientific literature—there is an undoubted lack to-day.

The books with which we have now to deal are diverse in character and quality, although appearing in the same series. Even in a short criticism it will be advisable to direct attention to the characteristics of books which are likely to fulfil the function of mental stimulants.

(1) Prof. Houston describes a number of volcanic eruptions and earthquakes. His theme is catastrophe, and he succeeds in producing an impressive compilation of historic disasters due to explosive eruptions or to earthquakes of the first magnitude. He is very precise in stating dates, and the heights—to the nearest foot—of volcanic summits. Our author may be given credit for picturesque descriptions, but it must be regretted that he adopts the cataclysmic geology of Dana. He even puts forward the abandoned theories of "geological revolutions"—with their concomitant exterminations of life—as though such views were generally held by geologists of the present day! We may regard the omission of this or that "important branch of the subject" as no real demerit; but we must condemn writings likely to implant fundamentally wrong ideas, which will provide much for youthful readers to unlearn.

(2) The subject of the second book in the series affords admirable opportunities for suggesting experiments such as would exercise the constructive instinct of his readers. Unfortunately, the opportunity is utilised to an extent which is practically negligible. A very wide range of topics is introduced, and the chapter on the Weather Bureau of the United States may be commended. Many anecdotes are introduced, but they do not suggest, nor would the book as a whole suggest, any steady advance of human knowledge. Exception may fairly be taken to many details, and the style is not calculated to promote accurate thinking. The author's account of Archimedes is regrettable. On such important matters as adiabatic expansion and the rise of clouds he betrays an inability to grip the essentials of the phenomena he sets out to explain.

(3) Mr. Tudor Jenks tells the story of mankind's acquisition of control over electricity, and in so doing gives us a book full of information—probably too full. The first hundred pages contain a considerable amount of biographical matter relating to discoveries from Lucretius to Morse. In books intended for boys it is wise to introduce biography; but this should be done by selecting a few pioneers of science, telling the story of their struggles and achievements with just so much detail as will give a vivid and realistic picture of the men and their surroundings. To do this requires the touch of the artist in words; it is not to be accomplished by relating long strings of events. Still less is it wise to try to tell the story of scientific discovery by snippets of information about a multitude of minor contributors to its progress. Mr. Jenks has been a painstaking student of the history of electricity, and has acquired extensive knowledge; our complaint is that he has compressed too much of this knowledge into a book intended for young people. In the latter half of the work he shows remarkable skill in con-

densing the manifold discoveries of recent years into small compass without sacrifice of accuracy. But he would have produced a more readable, and, we think, more effective book, had he ruthlessly cut out half his information, and expanded the other half so as to supply a series of more carefully graded explanations. A youth who has already made a hobby of electrical-instrument making or who has studied the subject successfully at school might read "Electricity for Young People" with interest, and in that case he would certainly read it with profit.

(4) In the fourth volume of the series, Mr. Jenks had an easier task, since "Photography for Young People" appeals directly to a favourite pursuit. There is a good chance of success for any book of moderate price which tells a boy with sufficient clearness the methods by which he can succeed in his hobby. In this book the young photographer will find good practical instructions, and a particularly clear exposition of the principles of the art he is striving to master. The author is at home alike when dealing with the beginnings of photography and when putting the latest discoveries within reach of the young amateur. Technical terms are properly treated, *i.e.* they are not evaded, but used after explanations have been given in simple language. The acquisition of such terms is enjoyed by a boy, and is good for him provided they are made to become part of his mental possessions—tools in his mental workshop. In each of these volumes a very fair standard is reached as regards illustrations, print, and binding. A plea may be urged for yet more copious illustrations in such books, as the youthful reader is greatly helped thereby. Both (3) and (4) are well indexed. G. F. D.

PHYSICAL ACOUSTICS.

(1) *A Text-book of Sound.* By Prof. E. H. Barton. Pp. xvi+687; illustrations. (London: Macmillan and Co., Ltd., 1908.) Price 10*s.* net.

(2) *Traité de Physique.* By O. D. Chwolson. Translated by E. Davaux. Tome i., fascicule iv. Acoustique. Pp. vii+873–1092. (Paris: A. Hermann, 1908.) Price 8 francs.

(1) PROBABLY no branch of physics is so poorly represented by text-books as that of sound. Between very elementary volumes and Lord Rayleigh's masterly treatise very little exists. The former are too trivial, while the latter is far too severe for the first or second year senior undergraduate. For this reason, amongst others, the present volume will be received gladly by both teacher and student, for it very adequately fills the gap in our expositional literature.

What, then, are the main characteristics of this book which confer superiority upon it? In the first place, the author does not hesitate to employ the elements of the calculus, although in many cases geometrical proofs are given as well. We think the day is now gone in which it was supposed that a student's undergraduate work could be carried on without reference to the calculus. We know that university regulations have in some cases encouraged this belief; but teachers have for a long time ignored these restrictions and have freely employed the calculus in their demonstrations. We hope that the time may come when mathematicians will see their way to give an adequate introduction to such methods in the first collegiate year. It is possible that some matters which are dear to them will need to be postponed until later in order that this may be done. The attempt is made, and satisfactorily so, in some schools; we hope that this practice will become universal. It is true that in some cases an exceedingly quick and convincing proof of a theorem can be obtained by geometrical methods; but, on the other hand, the present writer could lay his finger on pages of proof, partly algebraic, partly graphical, which could all be condensed into a few lines, and which have caused endless bother to the students with whom he has come in contact. Even in the book before us the graphical parts are not those which are clearest, though we have nothing but praise for the thorough way in which those parts are dealt with.

The second main characteristic is the close connection, maintained throughout, between theory and experiment. A treatise on sound is bound to be somewhat mathematical; but the author never misses a chance of introducing an experimental illustration or an account of some experimental verification of a theorem proved.

After a short preliminary survey the book continues with a somewhat long mathematical account of the kinematical and dynamical bases of the subject (including a chapter on elasticity). It is, perhaps, in this part that a curtailment might have been made. The elastic properties of bodies are now usually considered under the head of properties of matter. (By the way, is not the method for calculating the velocity of sound in a gas which starts by superposing an equal but opposite velocity due to Rankine? The author seems to imply that it is Rayleigh's method.) We regret that the part devoted both to the theoretical and experimental side of diffraction should be so short. Dr. Barton probably considers that this should be left to be treated in a text-book on light.

In the third place, we commend this book because it rings true to the spirit of research. The author has himself contributed in some degree to our knowledge of the subject, and he is abreast of the most recent work that has been done in connection with it. This is very notably the case in the large section which deals with musical instruments. Dr. Barton is specially qualified to deal with this side of the subject. The result is that we find here a compendium on the physical side of the qualities of musical instruments such as we believe cannot be found elsewhere.

Of recent work considered, mention may be made of Lord Rayleigh's work on the perception of sound direction, recent considerations in connection with the pressure of radiation, modern work on combination tones (no mention is made, however, of Barrett and Bolas's work on this subject), and the work of Sabine and of Marage on architectural acoustics. The last item is one in connection with which very little is definitely known, and to which research might very well be directed.